

PATENT ABSTRACTS OF JAPAN

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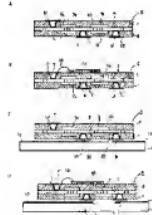
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(54) VIBRATING TYPE GYROSCOPIC SENSOR



(57)Abstract:

PROBLEM TO BE SOLVED: To provide a structure capable of reducing the electric cross talk between electrode leads on the drive side and the detection side of a vibrating type gyroscopic sensor and its detection noise.

SOLUTION: The electric cross talk between the drive side and the detection side can be reduced by extracting a driving wire and a detecting electrode through the through holes formed on the glass faces of different fixed substrates. The detection noise is reduced and the sensor can be miniaturized by mounting a separately manufactured amplifier on the extracting face side of the detecting electrode.

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CLAIMS

[Claim(s)]

[Claim 1] The oscillatory type gyroscope sensor which has a means to take the flow the object for a drive, and for detection from the principal plane from which a junction substrate differs in the oscillatory type gyroscope sensor which consists of a junction substrate which joined the fixed substrate and the flexible substrate, respectively.

[Claim 2] The oscillatory type gyroscope sensor according to claim 1 which laid the amplifier for detection currents in the ejection side of the detection electrode of a junction substrate.

[Claim 3] The oscillatory type gyroscope sensor according to claim 1 or 2 which joined the substrate for wiring to this flow means directly through the bump by the principal plane side of the junction substrate which established the flow means with the electrode for a drive.

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DETAILED DESCRIPTION

[Detailed Description of the Invention]

[0001]

[Field of the Invention] This invention requires this invention for amelioration of the oscillatory type gyroscope sensor manufactured using a silicon substrate, and it relates to the oscillatory type gyroscope sensor which consists of a configuration of having decreased the detection noise in the electric cross talk list during the electrode lead a driving side and by the side of detection in the flow structure which takes out wiring through a through tube.

[0002]

[Description of the Prior Art] Two or more pairs of electrostatic-capacity components by which attach an electrode in each opposed face of a fixed substrate and a flexible substrate, and opposite arrangement is carried out as an electrostatic-capacity mold acceleration sensor are prepared. Change of the acceleration of X of the Z-axis which sets up XY flat surface parallel to this substrate side, and intersects perpendicularly with this, Y, and the direction of a Z-axis three dimension The configuration which performs detection of each X, Y, and Z shaft-orientations component based on the electrostatic-capacity change between two or more pairs of electrostatic-capacity components is proposed (JP,4-148833,A, JP,4-337431,A, JP,5-188079,A).

[0003] Acceleration detection equipment and the angular rate assembly of the oscillatory type constituted and manufactured by the micro machine using a silicon substrate etc. are formed into a junction substrate by the electrostatic junction (anode plate junction) which joins without intervening adhesives or solder in the flexible substrate of vibrator and fixed substrates, such as a glass plate, which are produced from a silicon substrate.

[0004] With the configuration by which attaches an electrode in each opposed face of the aforementioned fixed substrate and a flexible substrate, and opposite

arrangement is carried out, in order for between the substrates concerned to detect that the electrostatic capacity which very narrow space is set up with several micrometers - 10 micrometers of numbers, and the gap of a movable electrode and a fixed electrode is changed, and is produced between two electrodes changes, it is necessary to pull out outside flow means, such as wiring (electrode lead) connected to two electrodes.

[0005] Moreover, since the pressure is changed with temperature, even when the air in the aforementioned narrow space is very slight, it is the existence which cannot be disregarded for minute vibrator, and it is desirable to decompress the interior of a sensor. However, or the interior of a sensor tended to have changed into the exterior and a free passage condition with said electrode lead etc., there were problems, like the special process for the closures is required and manufacturability is bad.

[0006]

[Problem(s) to be Solved by the Invention] Then, while preparing a through tube in fixed substrates, such as a glass plate, and aiming at a flow with the electrode by the side of a flexible substrate, the process is proposed by sealing a through tube by the configuration list which performs arrangement and the closure of an electrode lead (JP,6-160420,A, JP,8-122359,A, JP,10-90299,A, etc.). By this, the interior of a sensor can be made into the ambient atmosphere of reduced pressure or a request, and manufacture is easy and can offer a semi-conductor acceleration sensor with high reliability.

[0007] However, in the configuration which has arranged the flow means through a through tube, the problem which cannot disregard the effect of a detection noise in the electric cross talk list during the electrode lead a driving side and by the side of detection has arisen as the demand of high degree of accuracy or high sensitivity increases much more to today's oscillatory type gyroscope sensor.

[0008] This invention aims at offer of the oscillatory type gyroscope sensor which becomes an electric cross talk list during the electrode lead the driving side in this oscillatory type gyroscope sensor, and by the side of detection from the

configuration which can reduce a detection noise.

[0009]

[Means for Solving the Problem] Artificers did the knowledge of the ability to be able to decrease the electric cross talk a driving side and by the side of detection by performing ejection of wiring for a drive, and ejection of a detection electrode in the electric cross talk list during the electrode lead a driving side and by the side of detection through the through tube formed in the glass side of a different fixed substrate, as a result of examining many things for the purpose of reduction of a detection noise about the flow means of a driving side and the electrode by the side of detection.

[0010] moreover, in the configuration which takes a flow which is different on the front reverse side of the junction substrate which constitutes the above-mentioned sensor, by mounting the amplifier separately produced to the ejection side side of a detection electrode, artificers can realize the miniaturization of a sensor while reducing a detection noise -- thing knowledge was carried out and this invention was completed.

[0011] That is, this invention is an oscillatory type gyroscope sensor characterized by establishing each separate flow means from the principal plane from which it faces taking the flow the object for a drive, and for detection, respectively, and a junction substrate differs from the through tube prepared in the fixed substrate in the oscillatory type gyroscope sensor which consists of a junction substrate which joined the fixed substrate and the flexible substrate.

[0012] Moreover, this invention proposes collectively the configuration which joined the substrate for wiring to this flow means directly through the solder bump in the oscillatory type gyroscope sensor of the above-mentioned configuration by the principal plane side of the configuration which laid the amplifier for detection currents in the ejection side of the detection electrode of a junction substrate, and the junction substrate which established the flow means with the electrode for a drive.

[0013]

[Embodiment of the Invention] The oscillatory type gyroscope sensor by this invention is applicable to any well-known configuration. It is applicable also to the acceleration sensor which consists of various configurations, such as the configuration (JP,10-177034,A, JP,9-119944,A, JP,8-261850,A, etc.) which the applicant proposed, for example, 5 electrode molds which prepared radii-like four electrodes in the periphery section of a central circle electrode, 3 electrode molds (JP,11-38038,A) which consist of a circular electrode which divided the periphery into three equally, or a radial fin type of a cantilever structure.

[0014] The example of a configuration of the oscillatory type gyroscope sensor by this invention is explained in full detail based on a drawing. Drawing 1 A is an oscillatory type gyroscope sensor which becomes both sides of the silicon substrate 2 in which the well-known ring vibrator 1 was formed from the configuration of the junction substrate 5 which carried out anode plate junction of the glass substrates 3 and 4 respectively. In glass substrates 3 and 4, it becomes depressed according to ring vibrator 1 location, and Sections 3a, 3b, 4a, and 4b are formed, and when it makes with the junction substrate 5, it consists of a configuration which forms the vacuum cavities 6a and 6b.

[0015] According to the pattern of the electrode for detection arranged to the periphery side of the ring vibrator 1 of a silicon substrate 2, electric conduction film, such as aluminum, is formed in the through tube 7 for the detection electrodes prepared in the top glass substrate 3, and the detection electrode 10 is further formed on the glass substrate 3.

[0016] According to the pattern of the electrode for a drive similarly arranged to the core [of the ring vibrator 1 of a silicon substrate 2], and periphery side, electric conduction film, such as aluminum, is formed in the through tube 8 for drive electrodes prepared in the bottom glass substrate 4, and 9, and further, on the bottom glass substrate 4, the drive electrodes 11 and 12 are formed and it is.

[0017] The detection electrode 10 is formed through the through tube 7 for detection electrodes prepared in the top glass substrate 3 side joined to the silicon substrate 2 in which the ring vibrator 1 was formed. By forming the drive

electrodes 11 and 12 through the through tubes 8 and 9 for drive electrodes prepared in the bottom glass substrate 4 opposite to this, and arranging the flow means of the electrode the object for detection, and for a drive separately from both sides of the junction substrate 5 Since a physical distance is taken between both flow means, the electric cross talk a driving side and by the side of detection can be decreased remarkably.

[0018] In the configuration of above-mentioned drawing 1 A, the amplifier 20 for detection currents produced separately is mounted in the 3rd page of the top glass substrate which has arranged the detection electrode 10, it has connected with the detection electrode 10 with the wire 14, and the example shown in drawing 1 B can reduce a detection noise by this configuration. Furthermore, the miniaturization of a sensor is realizable.

[0019] The example shown in drawing 1 C lays directly the junction substrate 5 which consists of a configuration of above-mentioned drawing 1 A for example, in the wiring substrate 13 side necessary [equipped with the sensor concerned], it can make bumps, such as gold and solder, able to intervene between the drive electrodes 11 and 12 by the side of the bottom glass substrate 4, can be welded, and can mount it in each wiring 14 and 15 of the direct wiring substrate 13.

[0020] As shown in drawing 1 C, after the example shown in drawing 1 D makes a bump intervene between the drive electrodes 11 and 12 by the side of the bottom glass substrate 4 and mounts the junction substrate 5 which consists of a configuration of drawing 1 A in each wiring 14 and 15 of the wiring substrate 13, it mounts the amplifier 20 for detection currents in the 3rd page of the top glass substrate which has arranged the detection electrode 10.

[0021] By arranging the flow means of the electrode the object for detection, and for a drive separately from those both sides, it uses both sides of the junction substrate 5 effectively, and the junction substrate 5 for oscillatory type gyroscopes which consists of a configuration of this invention can raise the packaging density to an electrical circuit substrate it not only reduces the electric cross talk a driving side and by the side of detection, but, and can attain the

miniaturization of the whole equipment.

[0022] In this invention, it is possible to adopt as the flow means of each electrode which [besides the configuration which forms an electrode layer to an above-mentioned through tube / well-known] means. Moreover, this invention is employable even if it is other structures which do not carry out a vacuum lock besides the configuration of the oscillating gyroscope which carried out the vacuum lock of the interior of a cavity of a sensor, and vibrator.

[0023]

[Example] Drawing 2 A and B shows the top glass substrate 3 in drawing 1 , and has formed four through tubes 7 for detection electrodes in the top glass substrate 3. Drawing 2 C is shown in the silicon substrate 2 in which the ring vibrator 1 was formed, and has formed four poles of wiring patterns 17 and 18 the object for detection electrodes, and for drive electrodes at a time by turns. Drawing 2 D and E shows the bottom glass substrate 4 in drawing 1 , and has formed five through tubes 8 and 9 for drive electrodes in the bottom glass substrate 4.

[0024] The silicon substrate 2 was pinched between the top glass substrate 3 and the bottom glass substrate 4, 400 degrees C and predetermined anode plate junction which impresses the electrical potential difference of 800V were performed, one substrate was produced and membrane formation of the detection electrode by the aluminum film and a drive electrode and arrangement were carried out to both sides of a junction substrate.

[0025] Moreover, when producing the oscillatory type gyroscope sensor of a configuration like that of drawing 2 , the detection electrode and the drive electrode have been arranged to the top glass substrate 3 side, and it made with the sensor which has the conventional wiring configuration.

[0026] The electric cross talk during the electrode lead the driving side in the oscillatory type gyroscope sensor by this invention shown in drawing 2 and the sensor which has the above-mentioned conventional wiring configuration, and by the side of detection was measured, respectively. The measurement result had

reduction of 10 - 20% of electric cross talk possible for the sensor of this invention as compared with the conventional sensor.

[0027]

[Effect of the Invention] According to this invention, the electric cross talk a driving side and by the side of detection can be decreased by having formed the ejection of wiring for a drive, and the ejection of a detection electrode in the glass side of a different fixed substrate. Moreover, since a detection noise can be reduced and direct mounting of the drive electrode side of another side can be carried out through a bump at a wiring substrate by mounting the amplifier for detection currents produced separately in the ejection side of a detection electrode, the miniaturization of a sensor is realizable.

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DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]

[Drawing 1] A is the cross-section explanatory view showing the configuration of the oscillatory type gyroscope sensor by this invention, B is the cross-section explanatory view showing the configuration which mounted the amplifier for detection currents in the configuration of A Fig., C is the cross-section

explanatory view showing the configuration which mounts the oscillatory type gyroscope sensor of the configuration of A Fig. in a wiring substrate, and D is the cross-section explanatory view shown in the configuration which mounted the amplifier for detection currents in the configuration of C Fig.

[Drawing 2] The top-face explanatory view in which A and B show a top glass substrate, a side-face explanatory view, the top-face explanatory view in which 2C shows a silicon substrate 2, and D and E are the top-face explanatory views and side-face explanatory views showing a bottom glass substrate.

[Description of Notations]

- 1 Ring Vibrator
- 2 Silicon Substrate
- 3 Four Glass substrate
- 3a, 3b, 4a, 4b Hollow section
- 5 Junction Substrate
- 6a, 6b Vacuum cavity
- 7, 8, 9 Through tube
- 10 Detection Electrode
- 11 12 Drive electrode
- 13 Wiring Substrate
- 14 15 Wiring
- 16 Bump
- 17 Pattern for Detection Electrodes
- 18 Drive Electrode Pattern
- 20 Amplifier

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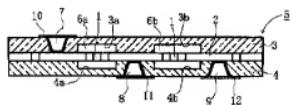
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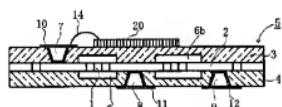
DRAWINGS

[Drawing 1]

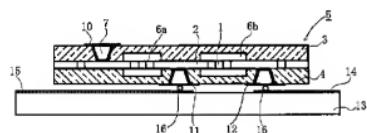
A



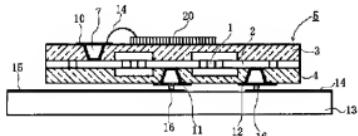
B



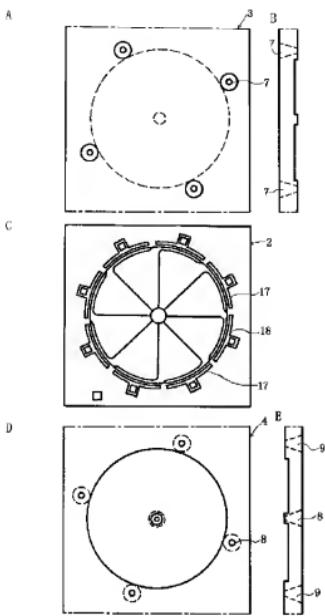
C



D



[Drawing 2]



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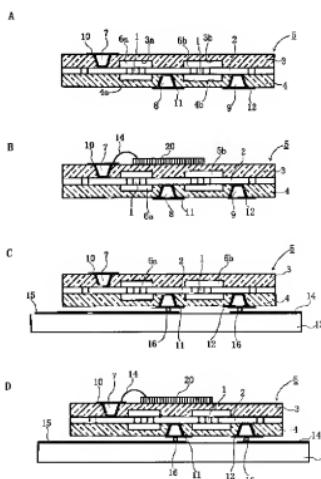
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(54)【発明の名称】 振動型ジャイロセンサ

(57)【要約】

【課題】 振動型ジャイロセンサにおける駆動側と検出側の電極リード間の電気的クロストーク並びに検出ノイズの低減が可能な構成の提供。

【解決手段】 駆動用配線の取り出しと検出電極の取り出しとを異なる固定基板のガラス面に形成した貫通孔を通して行うことにより、駆動側と検出側の電気的クロストークを減少でき、さらに、検出電極の取り出し面側に別途作製したアンプを実装することにより、検出ノイズを低減すると共にセンサの小型化を実現できる。



【特許請求の範囲】

【請求項1】 固定基板と可挠基板とを接合した接合基板からなる振動型ジャイロセンサにおいて、接合基板の異なる主面よりそれぞれ駆動用と検出用の導通を取る手段を有する振動型ジャイロセンサ。

【請求項2】 接合基板の検出電極の取り出し面に、検出電流用のアンプを載置した請求項1に記載の振動型ジャイロセンサ。

【請求項3】 駆動用電極との導通手段を設けた接合基板の主面側で、該導通手段とバンプを介して配線用基板とを直接接合した請求項1又は請求項2に記載の振動型ジャイロセンサ。

【発明の詳細な説明】

【0001】

【発明の属する技術分野】この発明は、この発明は、シリコン基板を使用して製造される振動型ジャイロセンサの改良に係り、貫通孔を通じて配線を取り出す導通構造において、駆動側と検出側の電極リード間の電気的クロストーク並びに検出ノイズを減少させた構成からなる振動型ジャイロセンサに関する。

【0002】

【従来の技術】静電容量型加速度センサとして、固定基板と可挠基板との各対向面に電極を設して対向配置される静電容量素子を複数対設け、該基板面に平行なXY平面を設定しこれと直交するZ軸のX、Y、Z軸3次元方向の加速度の変化を、複数対の静電容量素子間の静電容量変化に基づき各X、Y、Z軸方向成分の検出を行う構成が提案（特開平4-148833、特開平4-337431、特開平5-188079）されている。

【0003】シリコン基板を用いたマイクロマシン等により構成、製造される振動型の加速度検出装置や角速度検出装置は、シリコン基板から作成される振動子の可挠基板とガラス板などの固定基板とを、接着剤あるいは接合物を介在せずに接合を行う静電接合（陽極接合）等にて接合基板化される。

【0004】前記の固定基板と可挠基板との各対向面に電極を設して対向配置される構成で、当該基板間が数 μm ～数10 μm と極めて狭い空間が設定され、可動電極と固定電極の間隙が変動し、両電極間に生じる静電容量が変化するのを検出するため、両電極に接続された配線（電極リード）などの導通手段を外部に引き出す必要がある。

【0005】また、前記の狭い空間内の空気は温度によりその圧力が変動するため、僅かでも微小な振動子にとって無視できない存在であり、センサ内部を減圧することが望ましい。しかし、前記電極リードなどでセンサ内部が外部と連通状態となりやすい、あるいは封止用の特別なプロセスが必要で製造性が悪いなどの問題があつた。

【0006】

【発明が解決しようとする課題】そこで、ガラス板などの固定基板に貫通孔を設けて可挠基板側の電極との導通を図るとともに貫通孔を封着することにより、電極リードの配置と封止を行なう構成並びにプロセスが提案（特開平6-160420、特開平8-122359、特開平10-90299など）されている。これによって、センサ内部を減圧や所望の雰囲気につながり、製造が容易で信頼度の高い半導体加速度センサを提供できる。

【0007】しかし、今日の振動型ジャイロセンサに対して高精度や高感度の要求が一段と高まるにつれて、貫通孔を介して導通手段を配置した構成において、駆動側と検出側の電極リード間の電気的クロストーク並びに検出ノイズの影響が無視できない問題が生じてきた。

【0008】この発明は、かかる振動型ジャイロセンサにおける駆動側と検出側の電極リード間の電気的クロストーク並びに検出ノイズの低減が可能な構成からなる振動型ジャイロセンサの提供を目的としている。

【0009】

【課題を解決するための手段】発明者らは、駆動側と検出側の電極リード間の電気的クロストーク並びに検出ノイズの低減を目的に、駆動側と検出側の電極との導通手段について種々検討した結果、駆動用配線の取り出しと検出電極の取り出しとを異なる固定基板のガラス面に形成した貫通孔を通じて行なうことにより、駆動側と検出側の電気的クロストークを減少できることを知見した。

【0010】また、発明者らは、上記のセンサを構成する接合基板の表裏で異なる導通を取る構成において、検出電極の取り出し面側に別途作製したアンプを実装することにより、検出ノイズを低減すると共にセンサの小型化を実現できることを知見し、この発明を完成了。

【0011】すなわち、この発明は、固定基板と可挠基板とを接合した接合基板からなる振動型ジャイロセンサにおいて、固定基板に設けた貫通孔より駆動用と検出用の導通をそれぞれ取るに際して、接合基板の異なる主面より各々の別側の導通手段を設けたことを特徴とする振動型ジャイロセンサである。

【0012】また、この発明は、上記構成の振動型ジャイロセンサにおいて、接合基板の検出電極の取り出し面に検出電流用のアンプを載置した構成、駆動用電極との導通手段を設けた接合基板の主面側で、該導通手段と半田バンプを介して配線用基板とを直接接合した構成を併せて提案する。

【0013】

【発明の実施の形態】この発明による振動型ジャイロセンサは、公知のいずれの構成にも適用が可能である。出願人が提案した構成、例えば、中央の円電極の外周部に円弧状の4電極を設けた電極型（特開平10-177034、特開平9-119944、特開平8-261850など）、円周を3等分した円弧状電極からなる3電

極型（特開平11-38038）。あるいは片持ち構造のくし形などの種々の構成からなる加速度センサにも適用できる。

【0014】この発明による振動型ジャイロセンサの構成例を図面に基づいて詳述する。図1Aは、公知のリング振動子1を形成したシリコン基板2の両面に各々ガラス基板3、4を隅極接合した接合基板5の構成からなる振動型ジャイロセンサである。ガラス基板3、4にはリング振動子1位置に合わせて窓部3a、3b、4a、4bを設けてあり、接合基板5となした際に、真空キャビティ6a、6bを形成する構成からなる。

【0015】シリコン基板2のリング振動子1の外周側に配置した検出電極のバタンに合わせて、上側ガラス基板3に設けた検出電極用の貫通孔7内にはアルミニウムなどの導電膜が成膜され、さらにガラス基板3上に検出電極10が成膜されている。

【0016】同様にシリコン基板2のリング振動子1の中心部及び外周側に配置した駆動用電極のバタンに合わせて、下側ガラス基板4に設けた駆動電極用の貫通孔8、9内にはアルミニウムなどの導電膜が成膜され、さらに下側ガラス基板4上に駆動電極11、12が成膜されている。

【0017】リング振動子1を形成したシリコン基板2に接合した上側ガラス基板3側に設けた検出電極用の貫通孔7を介して検出電極10が成膜され、これとは反対の下側ガラス基板4に設けた駆動電極用の貫通孔8、9を介して駆動電極11、12が成膜され、接合基板5の両面から別々に検出用と駆動用の電極の導通手段が配置されることにより、両者の導通手段間に物理的な距離が取られるため、駆動側と検出側の電気的クロストークを著しく減少させることができる。

【0018】図1Bに示す例は、上述の図1Aの構成において、検出電極10を配置した上側ガラス基板3側に別途作製した検出電流用のアンプ20を実装し、検出電極10とワイヤ14で接続してあり、この構成によって検出ノイズを低減することができる。さらにセンサの小型化を実現することができる。

【0019】図1Cに示す例は、上述の図1Aの構成からなる接合基板5を、例えば当該センサを装着する所要の配線基板13側に直接、載置するもので、下側ガラス基板4側の駆動電極11、12に、金や半田などのバンプを介在させて溶着して直接配線基板13の各配線14、15に実装することができる。

【0020】図1Dに示す例は、図1Cに示すごとく図1Aの構成からなる接合基板5を、下側ガラス基板4側の駆動電極11、12にバンプを介在させて配線基板13の各配線14、15に実装した後、検出電極10を配置した上側ガラス基板3面に検出電流用のアンプ20を実装したものである。

【0021】この発明の構成からなる振動型ジャイロ用

の接合基板5は、その両面から別々に検出用と駆動用の電極の導通手段が配置されることにより、駆動側と検出側の電気的クロストークを低減するだけでなく、接合基板5の両面を有効活用して電気回路基板への実装密度を向上させることができ、装置全体の小型化を図ることが可能である。

【0022】この発明において、各電極の導通手段には、上述の貫通孔に電極膜を成膜する構成の他、公知のいずれの手段を採用することが可能である。また、この発明は、センサのキャビティ内部を真空封止した振動ジャイロ、振動子の構成ばかりか、真空封止しない他の構造などであっても採用できる。

【0023】

【実施例】図2A、Bは図1における上側ガラス基板3を示し、上側ガラス基板3には検出電極用の4個の貫通孔7を設けてある。図2Cはリング振動子1を形成したシリコン基板2に示し、検出電極用と駆動電極用の配線バタン17、18を交互に4種ずつ形成してある。図2D、Eは図1における下側ガラス基板4を示し、下側ガラス基板4には駆動電極用の5個の貫通孔8、9を設けてある。

【0024】上側ガラス基板3と下側ガラス基板4との間にシリコン基板2を挟み、400°C、800Vの電圧を印加する所定の隅極接合を行って一枚の基板を作製し、接合基板の両面にアルミニウム膜による検出電極と駆動電極の成膜、配置を行った。

【0025】また、図2のと同様構成の振動型ジャイロセンサを作製する際に、上側ガラス基板3側に検出電極と駆動電極を配置し、従来の配線構成を有するセンサとした。

【0026】図2に示すこの発明による振動型ジャイロセンサと上記の従来の配線構成を有するセンサにおける駆動側と検出側の電極リード間の電気的クロストークをそれぞれ測定した。測定結果は、この発明のセンサは、従来のセンサに比較して10～20%の電気的クロストークの低減が可能であった。

【0027】

【発明の効果】この発明によると、駆動用配線の取り出しと検出電極の取り出しとを異なる固定基板のガラス面に形成したことにより、駆動側と検出側の電気的クロストークを減少できる。また、検出電極の取り出し面に別途作製した検出電流用のアンプを実装することにより、検出ノイズを低減でき、他方の駆動電極側をバンプを介して配線基板に直接実装できることから、センサの小型化を実現できる。

【図面の簡単な説明】

【図1】Aはこの発明による振動型ジャイロセンサの構成を示す断面説明図であり、BはA図の構成に検出電流用のアンプを実装した構成を示す断面説明図であり、CはA図の構成の振動型ジャイロセンサを配線基板に実装

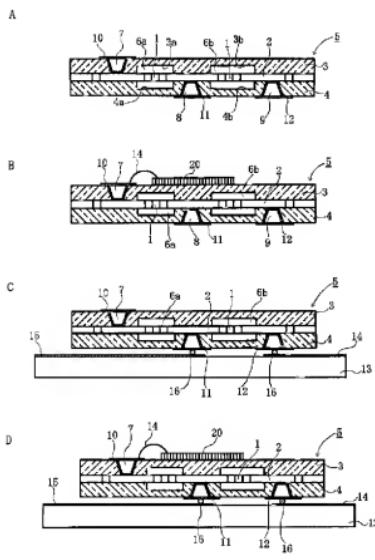
する構成を示す断面説明図であり、DはC図の構成に検出電流用のアンプを実装した構成を示す断面説明図である。

【図2】A, Bは上側ガラス基板を示す上面説明図と側面説明図、2Cはシリコン基板2を示す上面説明図、D, Eは下側ガラス基板を示す上面説明図と側面説明図である。

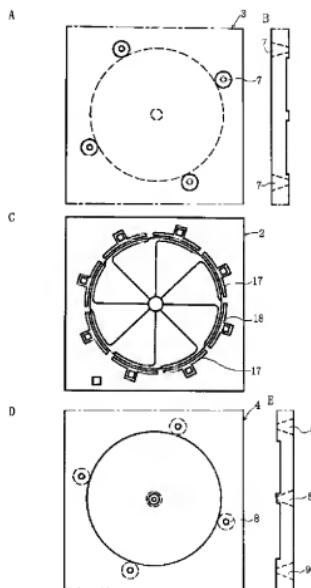
【符号の説明】

- 1 リング振動子
- 2 シリコン基板
- 3, 4 ガラス基板
- 3a, 3b, 4a, 4b 窪み部

【図1】



【図2】



5 接合基板

- 6a, 6b 真空キャビティ
- 7, 8, 9 貫通孔
- 10 検出電極
- 11, 12 駆動電極
- 13 配線基板
- 14, 15 配線
- 16 パンプ
- 17 検出電極用バタン
- 18 駆動電極バタン
- 20 アンプ